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# A RAND NOTE

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Managing Technological Change:  
The Process is Key

Don Mankin, Tora Bikson,  
Barbara Gutek, Cathleen Stasz

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**RAND**

**Institute for  
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Interactive Systems**

## PREFACE

This Note was originally published in the September 15, 1988 issue of *DATAMATION*. It presents results from three RAND studies of the implementation of new office information systems. Reports of these studies, listed below, can be obtained from The RAND Corporation's publications department:

Bikson, T.K., B.A. Gutek, and D. A. Mankin, *Implementing Computerized Procedures in Office Settings: Influences and Outcomes*, The RAND Corporation, R-3077-NSF/IRIS, October 1987.

Bikson, T.K., C. Stasz, and D. A. Mankin, *Computer-Mediated Work: Individual and Organizational Impact in One Corporate Headquarters*, The RAND Corporation, R-3308-OTA, November 1985.

Stasz, C., T.K. Bikson, and N. Z. Shapiro, *Assessing the Forest Service's Implementation of an Agency-Wide Information System: An Exploratory Study*, The RAND Corporation, N-2463-USFS, May 1986.

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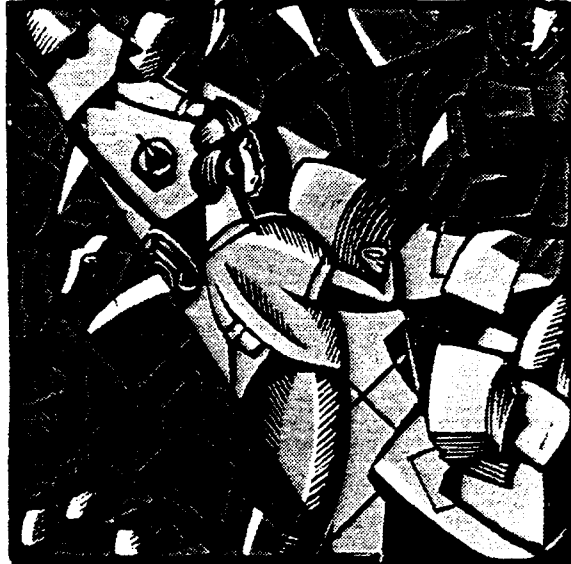


□ The headquarters of XYZ Corp. are charged with activity as shirt-sleeved employees move briskly through the large open office from one work area to another. Many of them are hunched over computer printouts and VDTs in groups of two or more, talking earnestly among themselves. Others meet in enclosed conference rooms for discussions that require quiet and privacy. Their expressions and voices reflect intensity and involvement. Rather than stress and distraction, they seem to derive stimulation and nourishment from their hectic environment.

In spite of their apparently busy schedules, the employees are eager to talk about their work. They are all bright, highly motivated, and decidedly upbeat about their jobs and career prospects. Critical comments are encouraged by management and expressed with candor and openness. The enthusiasm with which they view their work and its contribution to the organization is not what one would expect to find in a company that manufactures some of the most mundane consumer products found on supermarket shelves.

Most of these people use computers in their everyday work and feel that their job performance and the quality of their work lives has been significantly improved as a result. They view the computer as a tool, to be employed only when their work performance can be improved by its use. The same view is expressed by users at all levels and by top management. Users are allowed, even encouraged, to experiment with the technology to discover more effective ways to do their jobs, new functions, and new responsibilities. Many users have taken advantage of this opportunity to come up with creative reinventions of their tasks and tools.

The web of systems they use is complex and represents the state of the art. The not-always-compatible hardware, operating systems, databases, and software applications that comprise their technology have been adapted to different users and departments. Most applications can be modified, even by support-level employees (clerks, secretaries) and the overall system is designed to evolve as users' needs and skill levels change and as new technologies appear. Monitoring, guiding, and designing for these changes is the ongoing responsibility of a group comprised of end-user, management, and systems representatives. The overriding impression one takes away from a visit to XYZ is of an energetic, dynamic, and innovative organization well positioned to compete successfully in the information economy of the 1990s.



■ The reservations department of Company ABC is another story. The phones ring constantly with calls from customers wishing to book vacation travel plans. The calls are answered by reservations agents who are expected to complete a transaction within two minutes. They have almost no time between completing one call and answering the next.

The open office is so crowded that at least one agent must move her chair to clear the way for anyone to reach the manager's desk in the back. The crowding and the noise of the constantly ringing telephones create a chaotic, claustrophobic, and highly stressful work environment.

The stress is compounded by the firm's computer-based reservations system. The agents must respond to a fixed set of prompts in asking the customer for specific information (e.g., dates, the number of people in the party, the class of service requested, add-on packages) and entering that information into the system. The sequence, pace, and nature of the prompts cannot be changed. Coupled with the requirement that they answer the phones with little delay, ABC is more suggestive of an electronic sweatshop or information assembly line than a luxury service firm.

The manager complains frequently about the technology used, citing many faults and inadequacies. She has been instructed by top management, however, to "make the best of it." A friend of the president had recommended the system and wrote the firm's customized reservations applications software without discussion or input from anyone other than the president. Upon implementation, the software developer explained the system to the reservations manager who had responsibility for training the agents. No official documentation exists. The manager would like to try to change the reservations system, but without documentation or access to the person who wrote the software, she realizes this would be a nearly impossible task.

The agents' feelings about the system and their work are difficult to determine; they are not allowed time away from their work to answer questions. The high turnover rate—agents typically stay for six to eight months—suggests they are less than pleased. The rate is not surprising to the manager, given the pace of the work, the lack of control by the agents over its pace, the low pay and benefits, and the poor fit between the information system and work tasks. As a result, she typically tries to hire young women because "they are the only ones who can stand it here."

## Departmental Computing PART II

Three separate studies from the Rand Corp. show that management's traditional policies of trying to minimize change in a corporation's departments can be disastrous in implementing new technologies. Because technology is ever-changing, management must learn to accept, even nurture, the substantive change that technology causes.

# Managing Technological Change: The Process Is Key

**T**BY DON MANKIN,  
TORA BIKSON,  
BARBARA GUTEK,  
AND CATHLEEN STASZ

The scenarios recounted on the opposite page depict actual experiences and conditions in two companies with relatively new office information systems. Both companies were part of NSF and U.S. Congressional Office of Technology Assessment studies exploring the experiences of work groups undergoing changes in technology (see "The Study Process").

That technology—multifunction office information systems connected to large corporate databases—is similar in both examples, but the impact in each case is quite different. For XYZ, the new computer system has meant dramatically improved employee satisfaction, motivation, and involvement, and has increased work group performance and innovation. Since deploying the new system, XYZ has become a more vital, dynamic, and productive company.

For the employees of ABC, on the other hand, the computer has meant a decidedly more unpleasant work situation, which is reflected in low morale and high turnover. Furthermore, its prospects for future innovation and growth are poor.

Is it the technology that underlies the differences between the two companies? Not likely, since the technologies have so much in common. Is it the nature of the job tasks, occupational levels, or the organization's product or service? Again not likely, since counterexamples for each case are not difficult to find in our studies and elsewhere.

The key to a successful information

system, as a growing body of applied research on various organizations suggests, is the process by which the technology is introduced into the work group's everyday procedures.

Over the last several years, we have conducted a series of studies focusing on the ways in which new information systems are chosen, developed, introduced, and integrated into organizations' day-to-day operations. Those studies identified several factors critical to successful implementation and provided a number of examples of effective and not-so-effective procedures and policies.

Perhaps more important is what these studies tell us about shortfalls in traditional approaches to technological innovation. One of the most important characteristics of new technology is the chaotic pace at which new features, capabilities, and applications emerge. The pace of technological innovation and the uncertainty of predicting its specific form and its impact requires an organizational process of change that is as dynamic and flexible as the technology itself.

## Implementation of New Systems Is Ad Hoc

The studies show that most organizations pay little attention to the process of change once the decision has been made to acquire a particular system. They rarely plan for decreased productivity while users learn how to use the new systems and, aside from training, almost never budget for such non-hardware/software costs as meetings and planning procedures. The implementation effort frequently ends up as ad hoc fire fighting.

In an effective strategy, needs and goals should be identified before the

technological means for fulfilling them is decided upon; too often, the process is reversed, with a commitment made to a particular technology first.

These goals should not be spelled out in immutable and specific detail; the same goes for the steps and timetable needed to accomplish them. Rather, the key is to point in the desired direction and be prepared to modify those plans, systems, and strategies.

*After several months of lobbying by the technical services department, the management of Company DEF decided to purchase a new off-the-shelf computer system for the order processing department. (Company DEF represents a composite of actual organizations examined in the NSF and USFS studies.) The employees in order processing were informed officially of the imminent change in their work only a few days before delivery of the system (though apocalyptic rumors had been circulating for some time). A week later, when several employees arrived for work, they found at their desks a video display unit, a highly technical operating manual, and the vendor's phone number to call for help.*

*The logic guiding the assignment of computers to individuals seemed random at best and did not appear to reflect need, expected use, or skill level. At a general orientation session, users were given an introduction to the system, were trained in some basic functions, and were informed that they were expected to learn more in their spare time and to surpass present levels of performance within two weeks.*

*It took months of chaos and frustration before the department even reached prior levels of performance and several months more to register modest gains.*

Turnover quadrupled in the next four months. All in all, DEF was finally able to realize some labor savings but not nearly enough to make up for the cost of the system plus the unanticipated costs of increased turnover and productivity losses.

Company XYZ's implementation and training expenses accounted for half of total expenses for the new system. This budget covered the cost of activities such as man-hours involved in determining information needs, identifying and trying out applications, and restructuring work flow and tasks. Aside from a broad philosophical belief that desirable outcomes would result from providing well-trained and highly motivated people with the tools they need to do their work well, XYZ had

focused on few specific targets. After two years with the systems, XYZ had significantly cut total costs per unit output and increased their total market share.

The managers in the NSF study generally subscribed to one of three distinct sets of belief about effective implementation. We labeled these styles "bureaucratic" (management-dominated), "technocratic" (expert-dominated), and "democratic" (user-dominated). These styles correspond to the three groups that typically have a major stake in new information systems—top management, technical staff, and users (see "Implementation Styles of Different Stakeholders"). Our finding that none of the

three styles by itself is particularly effective suggests that successful implementation requires the involvement, commitment, and expertise of all three interest groups.

#### **Bureaucracy Hinders Implementation**

Top management is needed to provide general goals, encouragement, and, of course, support with money and other resources. In most cases, however, they should not be involved in the day-to-day operational details of the implementation. A bureaucratic implementation can result in a process that is overplanned, overmanaged, and leaves little room for alterations. Since top management's perspective is "the big picture," it is inclined to push for uniform systems that can serve the entire organization, but which may not serve any particular group of users very well.

Technical experts are needed to provide state-of-the-art information, hands-on assistance, and other technical resources. They are likely to favor technically challenging systems, and downplay considerations such as user skill level and the availability and ease of training. Such highly technical designs may result in serious mismatches between the capabilities of the system and the needs of the work group.

As is typical in systems planning, users in most of the sites included in our studies had relatively little say in development and implementation decisions. This oversight, unintentional or otherwise, comes at some peril to the ultimate success of these new systems.

User involvement helps the process in at least two ways. Firsthand knowledge of job tasks can be critical in developing systems that users will be able to operate successfully. Furthermore, their involvement in systems development can promote a feeling of ownership and a stronger commitment to making it work. User-dominated implementations can be technically deficient, however, especially if they are undersupported and underfunded—as they usually are.

It is clear that all three interest groups should be included in the implementation process. Why is this so rarely carried out in practice? Probably because some conflict is inevitable when users, executive management, and technical staff, with their different vocabularies, values, power bases, and goals in the organization, engage in a dialogue and in joint action. Effectively balancing and integrating these diverse voices can deter-

## **The Study Process**

The first study, under a grant from the National Science Foundation, was conducted between 1982 and 1984. It was an extensive investigation of the experiences of 55 different white-collar work groups in 26 organizations. Half of the organizations were manufacturing companies and half were service firms. The make up of the work group sample, each with a mean size of 10 employees, was 24% management and administration, 29% text-oriented professionals, 20% technical professionals, and 27% secretarial, clerical, and technical support groups. Out of a total of 530 employees, 45% were male and 55% were female; over 30% had advanced degrees and 40% had professional and technical degrees.

The employees in each work group anonymously filled out a questionnaire about their work, their use of new computer systems, and their perception of its impact and effectiveness. The study also included a semi-structured, open-ended interview with the managers of each work group or their designated representatives, as well as observational, archival information about the organization, work setting, and technology in use. We conducted a follow-up survey and interview of 24 of the original 55 work groups a year later to gather further information on issues that emerged in the first wave of data collection.

The second study, for the U.S. Congressional Office of Technology Assessment, focused on a medium-sized consumer products manufacturing firm (XYZ Corp.) that was part of the earlier cross-sectional study. Specifically, the objective was to explore and illustrate with qualitative data this organization's apparently successful approach to technological change.

At the national headquarters for the firm, four different, but related, white-collar work groups—market research, product development, planning, and financial control—were studied. From each work group, we interviewed a department head, four employees from various job levels and functions, and two "linking actors," or individuals outside the group with an intra-organizational perspective. Outside the work groups, we interviewed two executive managers, the director of personnel, two members of the technical department, and two people involved directly in the implementation process. The semi-structured interviews were designed to elicit information on the initial reasons for conversion to computerized procedures, how users were trained, subsequent changes in the nature of work, and effects on the organization's performance.

The third study explored the individual and organizational impacts of the United States Forest Service's newly implemented information system. Interviews were conducted at the national, regional, district, and forest levels with users and key actors in the implementation effort, ranging from top management and technical experts to forest rangers and district supervisors. The interviews focused on such issues as the rationale for the system, the planning and decision-making process, specific strategies for implementation at various organizational levels, how individual ranger functions can be supported by interactive information technology, and the potential effects of the information system.

## Implementation Styles of Different Stakeholders

### BUREAUCRATIC OR MANAGEMENT-DRIVEN

- Specific rules and procedures
- No risk taking
- Detailed cost justification
- Planned ahead, down to the last detail
- Centralized organizational structure with clear chain of command
- No self-instruction
- No flexibility; use of precise, fixed plans
- Top management makes most implementation decisions
- Lower-level employees are automated first

### TECHNOCRATIC OR EXPERT-DOMINATED

- Technical "entrepreneur" must lead change effort
- Does not involve affected employees in the planning
- Has a large R&D budget
- Technical experts make most implementation decisions
- Uses the mechanization of blue-collar work as a model
- Does not allow users a role in implementation decisions

### DEMOCRATIC OR USER-DRIVEN

- A majority of the employees must be in favor of the change
- Involves affected employees in the planning
- Customizes the technology to support the work to be done
- Rewards employees for taking part in the change process (rather than for direct achievements at that time)
- Has human resources professionals involved in training and work redesign
- Requires users to have an important role in implementation decisions
- Encourages risk taking

Source: Bikson, Gusek, and Mumkin.

mine whether the tension among them ends up being creative or destructive.

Early in the implementation effort, the employees of DEF's marketing department were asked to fill out a questionnaire about their work and associated information needs. This marked the end of DEF's attempt at user participation. A requirements analysis based on the survey was conducted by the technical services group, but the results of that assessment were never discussed with the users. Also, users were not given the opportunity to evaluate various technical approaches to meeting their needs, decisions about who in their department would gain the most from new software, or how the new system was to be implemented. To ensure compatibility with other systems in the organization, the technical services department made all decisions concerning systems design, acquisition, development, and implementation. After a brief but sincere attempt to use the new applications in their work, the users have gone back to their former methods, as the new computers gather dust on their desks.

Company XYZ organized a task force, which included technical staff from infor-

mation services, key members of executive management, and representatives from the user departments, to plan the development and implementation of their new information system. The task force eventually became a formal department set up to solve problems and plan projects related to systems (re)design, applications development, and support. The process does not always proceed smoothly, however. As one of the participants noted, "When you put a user together with a systems designer, what you get at first is nothing like what either of them had in mind . . . then they work on it!" Nonetheless, a high degree of satisfaction with the task force's efforts is apparent, and the final design reflects user input. Users feel committed to a system they helped develop, and the system works for them.

### Support for User Reinvention

If our studies are any indication, new office systems will enable most users to do their work in less time. What to do with these time savings, therefore, is a choice that organizations, managers, and users will have to address as these technologies become commonplace. These choices can make the difference

between modest short-term improvements in efficiency and more significant longer-term gains in productivity, work quality, and innovation.

One option for organizations is to use these savings to reduce their work force through layoffs (a rare occurrence in our studies) or attrition (the more widely pursued approach). Another, less obvious option is for managers to provide users with the freedom, resources, and incentives to explore the potential of the technology and to find new responsibilities and tasks to fulfill.

Most departments have at least one highly motivated user with some technical aptitude who learns the new technology more rapidly than his or her coworkers. On their own initiative, these local, de facto experts may develop special programs and procedures. As a result, their co-workers come to them when they experience difficulties in using the new technology or when they want to learn new tricks, making them into ad hoc trainers and technical consultants.

This job reinvention is not without its drawbacks. Users can get so absorbed in testing the limits of the technology and the boundaries of their jobs that they neglect their formal job responsibilities. Continual requests for assistance from co-workers may distract them further. At some point, management may have to choose between discouraging users from going beyond their job descriptions and, on the other hand, formally incorporating the new functions into their jobs. In the latter case, job level and pay may have to be upgraded to reflect these new responsibilities and skills.

Another problem occurs when experts leave the work groups that have become heavily dependent on the undocumented programs they have developed. One solution is for the organization to identify the best and most useful of these underground applications and provide the developer with the technical support needed to document the programs.

Melissa K., a secretary in the marketing department at Company DEF, initially viewed the new computers in her office with apprehension because it was rumored that they would eliminate at least two secretarial jobs within two years. Even though she was often bored at work and realized she was in a dead-end career, she did not want to lose her job to a machine. She was assured by her department head, however, that if any cuts were to be made, they would occur through attrition, and

that she would be provided with all the training and time she needed to learn to use the new system effectively. She was encouraged to experiment with the system to see if she could come up with new, more productive ways to do her job.

Melissa took little time to master the basics of the system and to use it regularly in her work. Finding herself with time on her hands, she developed her computer skills further through on-site training programs. With those skills, she developed several procedures to accomplish her tasks more effectively. Her co-workers increasingly turned to her to learn the advanced features of the system and how to apply her routines to their own work.

Eventually, her manager noticed that Melissa was spending more and more time helping her co-workers and devising new ways to apply the computer to the department's work. To recognize her inventiveness and increased skill level, her manager formally requested that the personnel department reclassify Melissa's job and increase her salary accordingly. The request was turned down because it "was against company policy." Unhappy with the decision, Melissa began to look elsewhere for a position more appropriate for her growing technical skills. Within three months she was working elsewhere in a higher-level, better-paying job.

#### **Adaptive Training**

The organizations in our studies employed a wide variety of resources for training and technical assistance, ranging from highly structured, vendor-sponsored, off-site courses to informal peer training provided by local experts, as described above. The most successful training programs we found feature an eclectic mix of resources and procedures that can be adapted to employees' widely varying interests and skill levels. This approach has the added advantage of being able to accommodate the varying rates at which users' needs and skill levels change. It also seems particularly well suited for midsize firms that cannot afford a large in-house training department or that lack a critical mass of users with similar substantive needs at the same stage of learning.

*Company XYZ's learning resources are diverse and flexible and vary somewhat by department. Since the market research and planning departments extensively use the same system, both make use of formal courses offered by the vendor. Basic courses are offered on-site. Advanced courses are offered off-site, and*

*interested users can take them at company expense. In R&D, the tasks are so specialized that general purpose introductory and intermediate courses are of little help. So, individuals rely on local experts who are willing to train them on a particular task, when both are free.*

*Informal peer training at XYZ is regarded as an inherent part of the way user departments operate. While there are no extrinsic incentives for de facto trainers, they appear to be motivated by the appreciation of their colleagues. Peer training is also widely believed to build cohesion and reciprocity in work groups.*

*Formal job descriptions and official work schedules at XYZ do not reflect this role, however. Those assuming this role simply try to find the time to fit in user training, making trade-offs between what they have to do for themselves and what they believe they should do for others. While they enjoy the role, they say that*

## **NEEDS AND GOALS SHOULD BE DECIDED BEFORE THE TECHNOLOGY.**

*learning support could be more effectively provided if some resources within the department were formally allocated for that purpose. In one department, demands on a particular expert's time were so great that his manager asked him to be less helpful and asked users to rely on him less.*

*How the eclectic training program at XYZ proceeds depends on the task to be learned, the number of users who must learn it, and the resources on hand or externally available.*

#### **Orientation to Change**

One of the best predictors of implementation success identified in the NSF study was "a positive orientation to change" (a standardized survey measure from *The Michigan Assessment of Organizations*, published by the University of Michigan's Institute for Social Research). Our case studies vividly demonstrate what this orientation entails: trying out hardware, software, and new work arrangements with the understanding that many of these changes may not

work and may have to be discarded eventually, learning from these experiments to plan and implement further change, and accepting continued change as a fact of organizational life.

*XYZ's management gave user departments the freedom to try out new things and get rid of tools that did not work well. Management also recognized and accepted the budgetary commitment needed to support experimentation; in the early stages of the system implementation they threw out about one fourth of their software acquisitions, by their estimates. Management at XYZ generally agrees that artificially imposing a steady state on the implementation process would have discouraged experimentation and risk-taking and prematurely placed a low ceiling on the productivity and value-added gains that were ultimately realized. As a result, individuals keep finding new ways of working, which generates a need for system modifications or extensions, which, in turn, creates a need for more new skills.*

While all of this uncertainty and change may seem like a nightmare to some organizations, others may see it as an opportunity for both innovation and the only truly effective means of coping with rapidly advancing technology.

#### **What About the Technology?**

Although not as important, perhaps, as the implementation process, certain properties of the technology itself are necessary for effective systems. These properties are not so much specific hardware and software features (e.g., the vendor, particular applications, display features) as they are generic qualities of the models or philosophies used to guide the development of these systems.

- **User-driven systems:** can be modified and manipulated by end users who have no special technical training or background in computers is one such property. Frequently, organizations select systems that are idiot-proof—easy to use, impossible to interfere with, and requiring little learning. Such systems, however, are also typically competency-proof—they allow little room for users to exercise their skills and ingenuity. User-driven systems, however, provide a powerful and flexible tool kit enabling users to learn about and exploit system capabilities in stages.

- **Systems designed for change:** the critical issue is how to provide employees with state-of-the-art tools when the art is rapidly advancing. Consequently, the sys-

tem has to be adaptable both to the emergence of new technology as it comes on the market and to reinvention as users acquire greater expertise. Many organizations try to acquire the right system, install it, provide training for it, and never change it. They soon learn that changes and updates are necessary—at great cost and with considerable difficulty and disruption. For the foreseeable future, organizations should probably view their systems as being in more of a development than a maintenance mode. Furthermore, many organizations will find that no single system or vendor can meet all of their needs and requirements. In the case of new office systems, at least, diversity is a good investment. As one interviewee at XYZ noted, "If we experiment enough with different systems, if one system that can meet all of our needs does come on the market, we will be able to recognize it."

Three general conclusions can be reached about the nature of these properties. First, they move beyond mere descriptions of technology to descriptions of the relationship between the technology, the users, and the functions and tasks to be accomplished. Second, these critical properties reflect, at the user and task level, the technology's inherent flexibility, functionality, and dynamic qualities. Third, these properties are what one would expect from systems implemented as described above. These implementation processes may be, in fact, the best way for an organization to realize a system with these characteristics.

#### **A Different Approach to Change**

The findings above, taken together, represent an approach to the management of technological change that differs significantly from what is typically practiced in most organizations. These differences can be seen in the primary focus of each approach and how each views the technology, the process of change, and the nature of the goals to be achieved.

While traditional approaches focus on technology, particularly hardware, our findings underscore the central importance of the processes by which the technology is developed and implemented. Traditional approaches also tend to view technology as a static physical entity. Once primary design and acquisition decisions have been made, organizations tend to think the system work is largely done and is independent of the particular social/behavioral contexts into which it is to be introduced. The technology is viewed as a given to which the organiza-

tion, work group, and user must adapt. The alternative approach stresses the inherent flexibility of the technology and its social/behavioral dimensions—how it is to be used, by whom, for what purposes. Mutual adaptation of technology to user and vice versa is the hallmark of this approach.

Most managers view the technology implementation process as having an easily marked beginning and a clear end, where results are identifiable. Their overall approach is to manage toward stability. As a result, they are often frustrated by their inability to do so. The emphasis is on getting it right. Alternatively, to reflect ongoing patterns of technological development, the implementation process can involve successive waves of organizational change that may dramatically alter the technologies, designs, and solutions left in the wake of preceding waves. Furthermore, this continuing

### **TECHNOLOGY HAS BEEN SEEN AS A STATIC PHYSICAL ENTITY.**

process is an interactive one that involves the participation of the users who will be most affected by the change.

The role and nature of systems goals are, perhaps, where the most striking differences between the two approaches emerge. Managers tend to choose goals that are specific, narrow, and easily defined and measured; the compelling, but false, sense of certainty and predictability of such goals often make it difficult for managers to do otherwise.

The particular goal most often chosen—cost or time reduction—can foreclose the innovation process prematurely, before significant gains of a different, and frequently unanticipated, sort are realized. These can include greater access to more timely data, product enhancement, improvements in work quality, new uses and applications, and long-term innovation.

A handy way to compare the different approaches is to view the traditional method as automating work processes

by using technology to replace labor, and the latter as augmenting work processes by providing users with a powerful new tool that will enable them to do things they were not able to do before.

The different ways the two approaches deal with the issue of goals can be seen as planning with goals vs. directional planning. The former is characterized by Michael McCaskey in *The Executive Challenge: Managing Change and Ambiguity*, (Pitman Publishing, Marshfield, Mass., 1982) as formal planning with specific goals and the latter as more open-ended and flexible.

"Success in a dynamic and changing environment," according to Daniel Robey's *Designing Organizations*, (Richard D. Irwin, Homewood, Ill., 1986) "is largely dependent on a flexible approach to planning, where opportunities are seized in spite of the fact that they do not fit into previously established objectives. . . . Directional planning shifts the focus away from goals and toward the general terrain where a company is heading. In this way it may discover interesting goals, but it does not commit itself to them beforehand."

The lesson from these studies is that instead of trying to minimize change, particularly with respect to new technologies, organizations need to learn how to accept it, even to encourage and nurture it. They need to understand how it progresses and to manage it so that they are in a position to take advantage of the opportunities it presents. Managing toward stasis with measurable objectives in mind is inconsistent with a dynamic and rapidly changing technology.

The technology has barely emerged from its infancy, and we have just begun to explore its organizational implications. Since questions about what will come next in terms of the technology cannot be answered with any certainty, organizations are presented with little choice but to manage the process of change and then let the outcomes take care of themselves. ■

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